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FINAL REPORT

MARCH 1990

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MIL-STD-1660 TEST ON
PALLET ADAPTER AND TOP LIFT ASSEMBLY
FOR 40MM CONTAINERS

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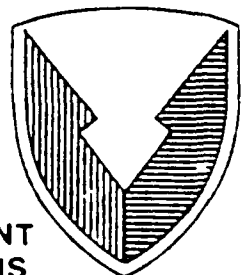
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MIL-STD-1660 TESTS ON
PALLET ADAPTER AND TOP LIFT ASSEMBLY
FOR 40MM CONTAINERS

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PART 1

INTRODUCTION

- A. BACKGROUND. The U.S. Army Defense Ammunition Center and School, Evaluation Division, was tasked by PM-AMMOLOG, AMCPM-AL, to test the pallet adapter and top lift assembly for 40mm containers.
- B. AUTHORITY. This test was conducted in accordance with mission responsibilities delegated by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), Rock Island, IL.
- C. OBJECTIVE. The objective of this series of tests was to assess the ability of the pallet adapter and top lift assembly to withstand forces incurred during handling, storage, and transport.

PART 2

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PART 3

TEST PROCEDURES

The test procedures outlined in this section were extracted from MIL-STD-1660. Design Criteria for Ammunition Unit Loads. 8 April 1977. This standard identifies five steps that a unitized load must undergo if it is considered to be acceptable. The five tests that were conducted on the test pallet are synopsized below.

1. STACKING TESTS. The unit load shall be loaded to simulate a stack of identical unit loads stacked 16 feet high, for a period of one hour. This stacking load is simulated by subjecting the unit load to a compression of weight equal to an equivalent 16-foot stacking height. The compression load is calculated in the following manner. The unit load weight is divided by the unit load height in inches and multiplied by 192. The resulting number is the equivalent compressive force of a 16-foot-high load.

2. REPETITIVE SHOCK TEST. The repetitive shock test shall be conducted in accordance with Method 5019, Federal Standard 101. The test procedure is as follows: The test specimen shall be placed on, but not fastened to, the platform. With the specimen in one position, vibrate the platform at 1/2-inch amplitude (1-inch double amplitude) starting at a frequency of about 3 cycles per second. Steadily increase the frequency until the package leaves the platform. The resonant frequency is achieved when a 1/16-inch-thick feeler gage may be momentarily slid freely between every point on the specimen in contact with the platform at some instance during the cycle or a platform acceleration achieves 1 ± 0.1 G. Midway into the testing period the specimen shall be rotated 90 degrees and the test continued for the duration. Unless failure occurs the total time of vibration shall be two hours if the specimen is tested in one position. When tested in more than one position, the total

time shall be three hours.

3. EDGEWISE ROTATIONAL DROP TEST. This test shall be conducted by using the procedures of Method 5008, Federal Standard 101. The procedure for the Edgewise Rotational Drop Test is as follows: The specimen shall be placed on its skids with one end of the pallet supported on a beam 4 1/2 inches high. The height of the beam shall be increased, if necessary, to ensure that there will be no support for the skids between the ends of the pallet when dropping takes place, but should not be high enough to cause the pallet to slide on the supports when the dropped end is raised for the drops. The unsupported end of the pallet shall then be raised and allowed to fall freely to the concrete pavement, or similar underlying surface from a prescribed height. Unless otherwise specified, the height of drop for level A protection shall conform to the following tabulation.

GROSS WEIGHT NOT EXCEEDING	DIMENSIONS ON ANY EDGE NOT EXCEEDING	HEIGHT OF DROP LEVEL A PROTECTION
600 lbs.	72 inches	36 inches
3,000 lbs.	no limit	24 inches
no limit	no limit	12 inches

4. IMPACT TEST. This test shall be conducted by using the procedure of Method 5023, Incline-Impact Test of Federal Standard 101. The procedure for the Incline-Impact Test is as follows: The specimen shall be placed on the carriage with the surface or edge which is to be impacted projecting at least 2 inches beyond the front end of the carriage. The carriage shall be brought to a predetermined position on the incline and released. If it is desired to concentrate the impact on any particular position on the container, a 4- x 4-inch timber may be attached to the bumper in the desired position before the test. No part of the timber shall be struck by the carriage. The position of the container on the carriage and the sequence in which surfaces

and edges are subjected to impacts may be at the option of the testing activity and will depend upon the objective of the tests. When the test is to determine satisfactory requirements for a container or pack, unless otherwise specified, the specimen shall be subjected to one impact on each surface that has each dimension less than 9.5 feet. Unless otherwise specified, the velocity at time of impact shall be 7 feet per second.

5. SLING COMPATIBILITY TEST. Unit loads utilizing special designs for nonstandard pallets shall be lifted, slung, lowered, or otherwise handled as necessary, using slings of the types normally used for handling the unit loads under consideration. Slings shall be easily attached and removed. Danger of slippage or disengagement when load is suspended shall be cause for rejection of the unit load.

PART 4

TEST EQUIPMENT

1. TEST PALLET

a. Drawing:	AC200000504
b. Unitization:	3 high x 2 wide x 7 deep
c. Width:	41 inches (104.14cm)
d. Length:	44.75 inches (113.67cm)
e. Height:	37.85 inches (96.14cm)
f. Weight:	2,330 pounds (1,059.1kg)

2. COMPRESSION TESTER.

a. Manufacturer:	Ormond Manufacturing
b. Platform:	60 inches by 60 inches
c. Compression Limit:	50,000 pounds
d. Tension Limit:	50,000 pounds

3. TRANSPORTATION SIMULATOR.

a. Manufacturer:	Gaynes Laboratory
b. Capacity:	6,000-pound pallet
c. Displacement:	1/2-inch Amplitude
d. Speed:	50 to 400 rpm
e. Platform:	5-foot by 8-foot

4. INCLINED RAMP.

a. Manufacturer:	Conbur Incline
b. Type:	Impact Tester
c. Grade:	10 percent Incline
d. Length:	12-foot Incline

PART 5
TEST RESULTS

MIL-STD-1660 TESTS

1. PALLET 1

a. Stacking Test.

The first test pallet was loaded to 12,163 pounds compression for a period of one hour. During and after the test no damage was noted.

b. Repetitive Shock Test.

During the first 90-minute cycle of vibration the pallet skids were lateral to the induced dynamic load. The test equipment during this cycle was operated at 210 revolutions per minute (rpm) which achieved the required 1/16-inch minimum clearance. The second 90-minute cycle of vibration was at 185 rpm with the pallet skids oriented longitudinal to the induced dynamic load. No damage was noted.

c. Edgewise Rotational Drop Test.

The first drop was perpendicular to the skids with this process repeated in a clockwise direction until all four sides of the pallet had been tested. One container was dented when the pallet impacted a forklift during one of the drops. No other damage was noted.

d. Impact Test.

The incline plane was set to allow the pallet to travel 8 feet prior to impacting a stationary wall. The pallet was rotated clockwise after each impact until all four sides had been tested. No damage was noted to the pallet adapter or top lift assembly during this test.

e. Sling Test.

The sling test consisted of five different lifting configurations using the top adapter assembly and a four-legged sling. The sling

configurations included three corners, two alternate corners, two adjacent corners, another pair of adjacent corners, and single corner lifts. The top lift assembly showed extreme bending during the three-legged-sling test (see photos). As a result, unitization was modified by moving the banding outward as far as possible to decrease the bending moment. The slinging test was then repeated with a new top lift assembly. The top lift assembly still showed slight bending during the three-legged-sling test. The bending in the top lift assembly worsened during the two-legged-sling test on opposite corners.

f. Disassembly Test.

Two of four stacking lugs failed on the pallet adapter during MIL-STD-1660 testing. Since the lugs are not visible while the pallet is assembled, it is undetermined when the failure occurred.

2. PALLET 2

a. Stacking Test.

The second pallet tested was loaded to 12,272 pounds compression for a period of one hour. During this test no damage to the pallet was noted.

b. Repetitive Shock Test.

During the first 90-minute cycle of vibration the pallet skids were positioned longitudinal to the induced dynamic load. The test equipment during this cycle was operated at 185 rpm during the first cycle and 210 rpm during the second 90-minute cycle. No problems were encountered during this test.

c. Edgewise Rotational Drop Test.

The first drop was made parallel to the skids and proceeded clockwise. No problems were noted during the four drops.

d. Impact Test.

The first impact was made parallel to the skids and proceeded clockwise. One container shifted toward the interior of the pallet. No

damage was noted during this test.

e. Sling Test.

The top lift assembly showed slight bending during the three-legged-sling test. The bending worsened during the two-legged-sling test on opposite corners.

f. Disassembly Test.

All four stacking lugs failed on the pallet adapter during the MIL-STD-1660 testing. Since the lugs are not visible while the pallet is assembled, it is undetermined when the failure occurred.

3. PALLET 3

a. Stacking Test.

The third pallet tested was loaded to 12,240 pounds compression for a period of one hour with no problems noted.

b. Repetitive Shock Test.

During the first 90-minute cycle of vibration the pallet skids were positioned lateral to the induced dynamic load with the vibration table set at 205 rpm. During the second 90-minute cycle of vibration the test equipment was set at 15 rpm with no pallet damage noted.

c. Edgewise Rotational Drop Test.

The first drop was made parallel to the skids and proceeded counterclockwise. No problems were noted during the four drops.

d. Impact Test.

The first impact was made parallel to the skids and proceeded counterclockwise. No damage was noted during this test.

e. Sling Test.

The top lift assembly showed slight bending during the three-legged-sling test. The bending worsened during the two-legged-sling test on opposite corners.

f. Disassembly Test.

All four stacking lugs failed on the pallet adapter during the MIL-STD-1660 testing. Since the lugs are not visible while the pallet is assembled, it is undetermined when failure occurred.

PART 6

CONCLUSIONS AND RECOMMENDATIONS

1. CONCLUSIONS.

The pallet adapter and top lift assembly failed MIL-STD-1660 Design Criteria for Ammunition Unit Loads. The top lift assembly did not show structural soundness, since permanent deformation occurred during slinging tests on all of the top lift assemblies (see photos). All pallets tested had stacking lug failure with the pallet adapter due to fracture. Recommendations given below will reduce the chances of this happening on production pallets.

2. RECOMMENDATIONS.

a. Strengthen the lateral members of the top lift assembly to avoid the bending during top lift which has occurred consistently in MIL-STD-1660 tests conducted.

b. Increase the strength of the stacking lugs to avoid fracture which has occurred repeatedly during testing of this and other pallets.

PART 7
PHOTOGRAPHS



90-2200

DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 1 This photo shows the deformation in the top lift assembly due to the slinging test.



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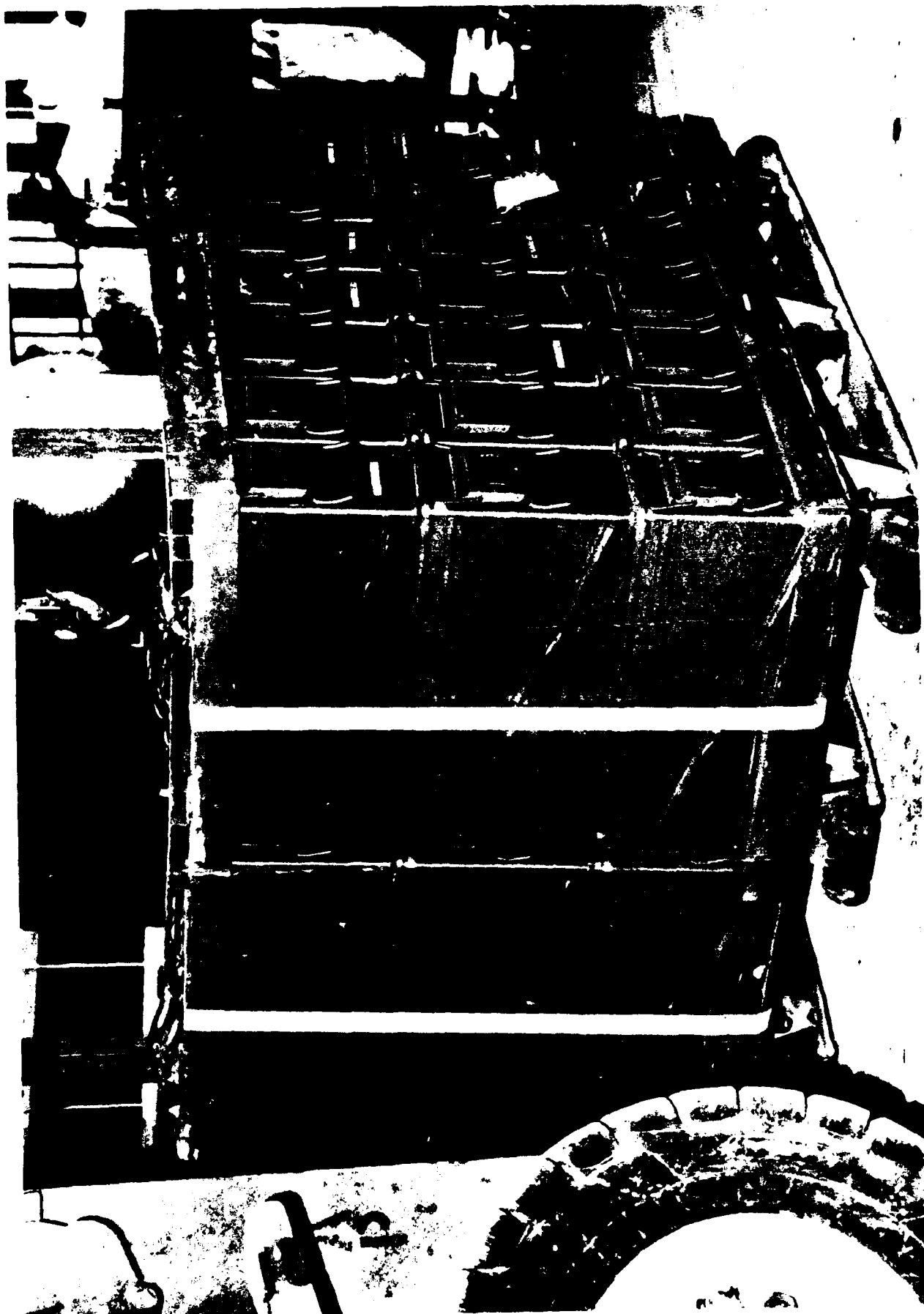
Photo No. 2 This photo shows the deformation in the top lift assembly due to the slinging test.



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Photo No. 3 This photo shows the deformation in the top lift assembly due to the slinging test.



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Photo No. 4 This photo shows the deformation in the top lift assembly due to the slinging test.



90-2199

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Photo No. 5 This photo shows the deformation in the top lift assembly due to the slinging test.



90-2195

DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 6 This photo shows the damage to the lateral members of the top lift assembly due to the slinging test.